

CONTRIBUTION TO OUR KNOWLEDGE OF THE MORPHOLOGY AND SYSTEMATICS OF THE *POLYCTENIDAE*, A FAMILY OF RHYNCHOTA PARASITIC ON BATS.

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(With Plates XII., XIII., XIV.)

AMONG the insects entrusted to us by the authorities of the British Museum (Natural History) for the purpose of identification we found some forms of *Polyctenidae* which did not agree with any of the figures published by Horváth, Speiser, Waterhouse, and others, and necessitated, therefore, a closer research into the literature on the subject, and a comparison of the allied species, before the supposed new forms could be considered as hitherto unknown to science. We had the good fortune of being enabled to study in the British Museum the types of *Polyctenidae*, i.e. the nomenclatorial types, contained in that institute, and which the authorities on this family had not seen, as types cannot be lent out by the British Museum. Having once embarked upon the task of comparing the unidentified forms with the types, figures, and descriptions, we soon found that the material of the British Museum collection, together with the specimens received by the Entomological Research Committee (Tropical Africa), placed us in such a favourable position that we deemed it advisable, for the sake of other students of this group, to enter more closely upon the subject.

The *Polyctenidae* are only known from bats in the Tropics and Subtropics of the Eastern as well as the Western Hemisphere, and appear to be very rare. The collection of the British Museum comprises only 27 specimens; but this number is very large in comparison, as less than a dozen specimens are mentioned as being contained in other collections. This rarity is not merely apparent, as in the case of so many other insects, but is real, we believe. The explanation of the rarity lies in the fact that the *Polyctenidae* are viviparous, and produce the young in such a very advanced stage that the progeny must necessarily be exceedingly limited in numbers. The discovery of the method of propagation of these parasites is entirely due to the removal into balsam of some specimens from the cardboard on which—unfortunately—they were pasted. We hope that it will not be considered impertinent on our part if we draw attention to the necessity of preserving *Polyctenidae* either in alcohol or mounted on a slide. As everybody who has studied these insects knows, the underside offers very important taxonomic characters. The number of segments in the rostrum, the structure of the first antennal segment, the shape of the throat-part of the head, the outlines of the sterna, and the number and position of the bristles on the under surface are in several instances far better (and sometimes the only sure) guides in identifying allied species than the upper surface, and it goes without saying that these organs *must* be compared if an attempt at classifying the species is made. Carded specimens, which only exhibit the upper surface (carrying a coat of minute dust revealed under the microscope), and, when soaked off the card, show the under side smothered in glue or shellac, are very distressing. We find it most convenient for all purposes if some specimens of a species are kept in alcohol and

others mounted flat in balsam. We employ a perforated slide with a thin coverslip as a bottom on which the specimen rests, another coverslip lying on top of the specimen. This method allows the insect to be studied equally well from both sides.

The 27 specimens of the British Museum, which are now all transferred into alcohol or mounted in balsam, represent, we think, all the species which are known of this family.

As has already been clearly demonstrated by Speiser,* the *Polytenidae* are nearly related to the *Cimicidae*. The agreement in the structure of these two families of *Rhynchota* is indeed so close that no other place could be assigned to the Polytenids than nearest to the bed-bugs.

MORPHOLOGY.

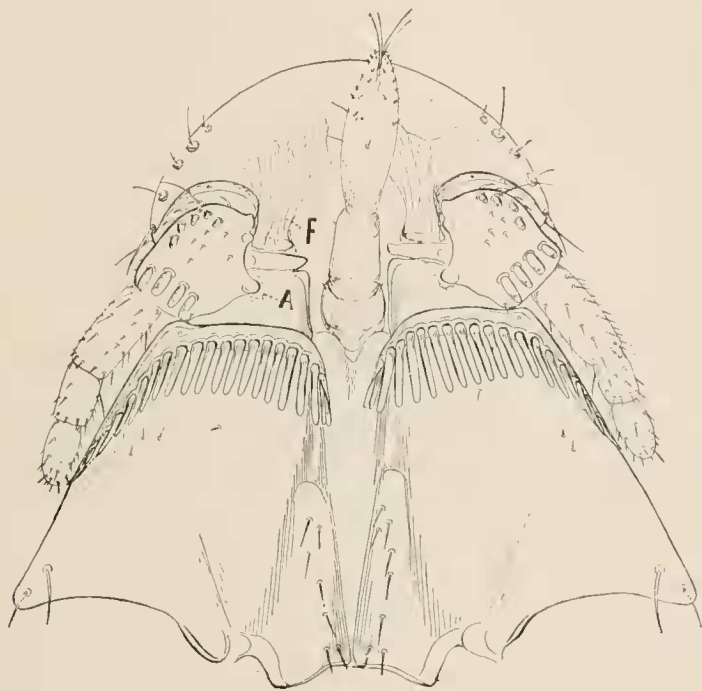
Our knowledge of the exoskeleton of these bat-parasites is mainly based on Westwood's original figures in *Thesaur. Oxon.*, which in beauty of drawing, as well as in clearness of the detail necessary for the recognition of the species, far surpasses everything that has been published since on this family. However, the figures are not correct in every detail, chiefly owing to the state of preservation of the specimens, and to the fact—always an important one—that the figures were the first which illustrated the morphology of a type of insect until then unknown. The internal anatomy of the *Polytenidae* has not yet been investigated.

The most interesting features in these insects is the great modification of the head and anterior legs, which are quite different from these parts in other *Rhynchota*, the movable luniform clipeus especially being a character of the *Polytenidae* unique in that order. This clipeus is generally represented as being separated from the head by a groove on the upper as well as the under side, Waterhouse's figure of *P. spasmae* (1879) being an exception. In this figure the under side of the head is drawn as being devoid of the dividing-groove, in which the figure is quite correct. As an examination of specimens in alcohol proves, the groove is present only on the upper side, merely shining through beneath, the under surface of the clipeus being covered by a thin membrane, which is continuous with the membrane of the head.

In a dorsal view (Pl. XII.—XIV. figs. 1. 3. 5. 8. 10) the clipeus projects laterally beyond the edge of the frons, there being here a gap between the clipeus and the head which is filled up by the apical portion of the first segment of the antenna. The hind edge of the clipeus is always crescent-shaped centrally, the curve being sometimes stronger and sometimes flatter, and there is often a slight indentation at each side of the central portion of the arch. The sides of the hind margin are curved in the inverse sense, and always bear a number of bristles, which are directed obliquely upwards, the most lateral of these bristles being the longest. There is a double outline to the hind margin, owing to the clipeus having a certain thickness and the upper edge of the margin projecting farther backward than the lower edge, so that the upper edge slightly overlaps the anterior margin of the frons when the clipeus is bent upwards. On the under side we find, near each antenna, a kind of hasp and angle connecting the clipeus with the head. This consists, on the clipeus, of a more or less ribbed incrustation in fan-shape, which narrows posteriorly, where it is raised and meets a corresponding elevation

* *Zool. Jahrbüch.*, Suppl. vii. p. 373. tab. 20 (1904); id. *Rec. Ind. Mus.* iii. p. 271 (1909).

on the head. This fan (F) is not always so distinct as in our text-fig. 1. The whole arrangement, however, appears to act also as a buffer when the clipens is bent down too much. The movability of the clipens is very limited, as tested at alcohol specimens. The organ cannot freely be flapped up and down, but only be tilted at an obtuse angle, its halfmoon-shape and the membranous connection with the head alone would, under ordinary circumstances, prevent any too great upward or downward movement. But even under exceptional pressure from front, the helmet, on account of the buffer, cannot flap so much down as to be in the way of the proboscis when the latter is stretched downward and perhaps a little forward in the act of sucking. At the lateral margin there are always four grooves whose



TEXT-FIG. 1.

posterior edges are more or less strongly raised in tubercle shape, each groove bearing a very thin bristle, the anterior groove generally two very small ones. Near the angle there is, as above, a long bristle. In one of the species (Pl. XIV. fig. 11. 12) three of these bristles are replaced by short, thick, stumpy spines, and the posterior bristle is proximally broad and ends in a long point, the anterior groove, whose edges are not elevate, bearing several minute hairs. The lateral posterior portion of the clipens is more or less excavated to allow for the reception of the first antennal segment.

The proboscis is described as consisting of three segments, and containing four long bristle-like piercing organs. This statement does not appear to have ever been modified. It is true that in Speiser's figure of *intermedius* (1904) the proboscis is divided into four segments, but that is clearly due to a mistake on the part of the lithographer. As regards the number of segments, we find that

some species have three and others four segments, the first segment being always very short; cf. Pl. XII.—XIV. figs. 2, 4, 6, 11, and text-fig. 1. The proboscis is rather soft, and the first and second segments, sometimes also the third, are more or less open on the anterior side, while the end-segment, which is longer than the preceding one, bears a mesial groove on that side, but does not appear to be open. The slit in the first and second segments is not covered by an upper lip, as in the *Rhynchota*. We have moved the proboscis freely, but failed, either by pressure or bending, to find an organ which might be homologous to the labrum, and we consider it possible that the so-called clipeus really is homologous with the labrum. However, transverse sections may reveal the presence of a remnant of this organ. All the segments of the proboscis bear short hairs, those on the last one being fairly numerous and more or less symmetrical in position. This segment, moreover, is provided at the apex with a number of short papillae, and its length and shape is by no means the same in the various species.

The proboscis is carried with the tip pointing backwards, as in a bug, and there is a deep mesial groove on the head for its reception (Pl. XII. fig. 2, 4), the raised edges of this groove, some hairs placed on these edges, and the spines of the comb presumably preventing friction with the hairs of the host when the insect dives into the fur.

The upper side of the head is divided into a flat or depressed central portion and the depressed sides. The central portion is anteriorly parallel with the hind margin of the clipeus, or very nearly, and its lateral edge is more or less elevate, cariniform and continued backwards, being accompanied in adult specimens by a suture, at the outer side of which there is a row of bristles. The raised edge of the central area serves in most Old-World species a distinct purpose in connection with the lateral depression. As indicated in fig. 3 of Pl. XII., the antenna, when at rest, lies on the upper side of the head in the groove bounded by the carina. The suture which extends, on the upper side, from the point where the lateral depression commences, corresponds most probably to the suture which is situated between the antennae in many other insects, separating the frons from the vertex.

While in most species the head is more or less closely applied to the prothorax (cf. Pl. XIII. and XIV. fig. 5, 8, 10), there is sometimes a distinct neck between them (Pl. XII. fig. 1, 3), in the latter case the angles of the head being more obtuse than in the former. It is very interesting to note that the posterior angles bear a long bristle above as well as below in the species with a neck, while such bristles are absent in the other species. Bristles placed in this way in front of a gap or open joint are met with posteriorly on the pronotum of the *Polyctenidae* and in some cases also on the sides of the elytra. They are a feature common to many ectoparasites living in fur, and have evidently the function of warding off hairs which otherwise might get into the joints.

The difference which exists in the shape of the frons and the number and position of the bristles is sufficiently apparent from our figures, and does not require further comment; but we should like to draw attention to a small character which is only present in some nearly related Old-World forms and has been overlooked. This is a row of exceedingly small spines placed on each side of the head in front of the comb (Pl. XIII. fig. 5, 8). We mention this character especially, because we have here one of the very numerous instances where apparently insignificant distinctions are surprisingly constant outward expressions of true relationship.

As said above, the under surface of the head is elevated at each side of the

centre, by which means the proboscis-groove is formed. The bristles placed on this central area, presumably as a protection for the proboscis, vary much according to the species, and the central portion of the hind margin exhibits also considerable differences in outline in the various genera. The sides of the under surface are deeply hollowed out, the anterior and lateral margins of the cavity being armed with a comb of flat, obtuse, spines. The comb varies especially in the development of the lateral spines. In some species these spines are small and do not project beyond the edge of the head (Pl. XIII. fig. 5. 6. 8), in other forms they are much longer than the anterior spines and are visible from above (Pl. XII. fig. 1. 2. 3. 4). The spines on each side of the proboscis-groove are usually much nearer together at their tips than at their bases, projecting considerably over the groove. In order to allow the proboscis to pass through the gap between these spines the second segment of the proboscis is narrowed, which is especially noticeable in fig. 2 and 4 of Pl. XII. The comb is present in all the specimens, adult and immature, which we have seen, with the exception of one very young individual of *Hesperoctenes*, in which a similarly arched comb is situated on the first segment of the antenna instead.

The antennae are always four-segmented. Their length and armature and especially also the shape of the first segment afford characters of considerable taxonomic value. The variability within the limits of a species is slight as regards mature specimens. In the drawings hitherto published the insertion of the antenna in the head has not been clearly indicated. When moving the antenna of specimens preserved in alcohol, one distinctly notices that it is joined to the head with its posterior corner marked A in our text-fig. 1 (p. 557). The first segment can easily be moved horizontally to a limited extent, but the pivot on which it works allows also some downward movement of the anterior margin (*i.e.* a slight turning of the antenna) and of the apical margin (*i.e.* a downward flapping of the antenna). The mature Old-World species have the first segment provided with a median or a subapical row of blunt spines and an anterior row of smaller ones. The adult American specimens bear pointed, and more or less slender, bristles instead. Immature specimens of the Eastern Hemisphere may have bristles only (Pl. XII. fig. 4) or spines as well (text-fig. 1), while the only young American specimen which we have seen has a regular curved comb of spines on this antennal segment, replacing the gular comb of the head. The second segment is always longer than either of the following two, and is more or less cylindrical in those species which carry the antenna on the upper side of the prothorax, probably when moving through the fur. In the American species and one of the Old-World forms (Pl. XIV. fig. 10. 11) the inner surface of the segment is longitudinally impressed, and there is a comb of spines at the upper edge of this groove and some long bristles near the lower. In these species the antenna is laid along the side of the pronotum, whose edge fits in between the comb and bristles. The apical segment is always pale at the tip and bears here some pale hairs, which presumably have a sensory function.

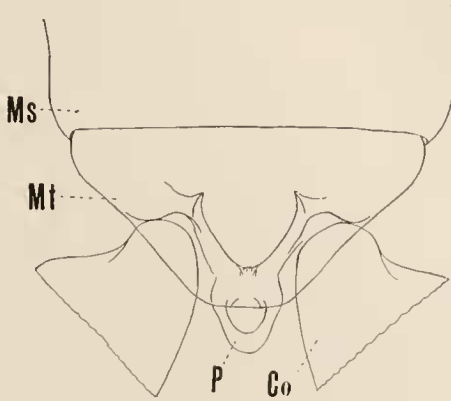
The upper surface of the head, thorax and elytra is always flattened in the centre, never markedly convex, excepting the sides, and the thorax and elytra often have a distinctly impressed mesial line. The sides of the prothorax and elytra, however, are always convex and flexed downwards. The prothorax, being laterally hollow underneath, varies in outline to a certain extent according as the margin is more or less curved downward, which often depends on the state of preservation of the individual. One of the specimens of *nycteridis*, for instance, has an

asymmetrical prothorax, only one side being curved down as usual. The pronotum is transversely oblong in the American forms and one African species (Pl. XIV. fig. 10), or is rounded at the sides and anteriorly more or less distinctly narrowed. In all the Old-World species it bears anteriorly on each side a transverse row of three or four long bristles. It is never evenly hairy all over, there being always some naked spaces, whose extent differs often according to species. There is no comb at the hind margin in the American *Polyctenids*, nor have any of our immature Old-World specimens a pronotal comb, while all the adult examples we have seen are provided with it, one new species (Pl. XIV. fig. 10) even bearing a second comb of short spines with a row of long bristles in front of the hind margin. The punctures which Speiser mentions of the two species described by him (*talpa* and *intermedius*) are present in all mature forms, but are numerous in some and less so in others.

The elytra are always fused together proximally, the slit which separates them from one another posteriorly never reaching down to the base; but there is always an impressed line from the slit forward. They differ considerably in size and shape in some of the species, being transverse in the American forms and as a rule rounded together, or each separately rounded at the side and apex in the Old-World species. As in the case of the head and pronotum, some species have a comb, others are without it, the American never bearing a comb of spines on the upper side. The base of the elytra is concealed underneath the overlapping hind edge of the pronotum, but is distinctly visible through the pronotum in specimens mounted in balsam. Immature specimens have smaller elytra than adult ones, and the apical median sinus which separates them is generally large with its extreme tip rounded off, but there is sometimes a sutural slit in nymphs as in adults (Pl. XIII. fig. 8).

The variety obtaining in the outlines and armature of the pronotum and elytra is equalled if not surpassed by the diversity in the development of the thoracic sternites. There are two main lines of development in the underside of the thorax. The forms with a transverse, more or less quadrangular, pronotum have the more primitive sternal sclerites. The prosternum is triangular and does not extend in between the coxae (Pl. XIV. fig. 10), the apex of the sclerite either being obtuse (the African species figured) or more pointed (the American *Polyctenids*). Behind the fore coxae the endoskeleton (apophysis) is distinctly visible. In the second type, to which all the Old-World species belong with the exception of the new African species figured on Pl. XIV., the prosternum is longer, being produced into a pointed or obtuse process which extends in between the fore coxae (Pl. XII. fig. 4, XIII. fig. 6) and nearly touches the mesosternum. This intercoxal process is not essentially different in adult and immature specimens of the same species. The mesosternum is transverse in the American forms, anteriorly somewhat excised and posteriorly truncate. The metasternum is contiguous with it, and resembles an abdominal sternite except in extending forward laterally to the midcoxal acetabulum. Pl. XIV. fig. 11 represents a similar type inasmuch as the metasternum is transverse, but this type differs very much in the shape of both the meso- and metasterna, the latter sclerite being small, not reaching the sides of the metasternite, and being separated from the mesosternum by a membranous interspace. Moreover, the episternum of the metasternite, instead of being nearly square, as in the American *Polyctenidae*, is transverse. The other species, some occurring in Africa and others in Asia, also have two distinct types of meso-metasterna, one of which is illustrated by text-fig. 2. Here the mesosternum (Ms) is anteriorly more or less rounded and convex, and the suture separating it from the metasternum is straight and lies

closely behind the mid coxae. The metasternum is anteriorly nearly as wide as the mesosternum is posteriorly, and is strongly rounded, being much broader than long. From underneath this sclerite projects an obtuse intercoxal process, the mesosternum overlapping the bases of the hind coxae. The process is hollow underneath, being a kind of half-cylinder. The remaining species conform in these sclerites to Pl. XIII. fig. 6, apart from the mesosternum being much longer in some species than in the form represented by our figure 6. In these species the metasternum (central sclerite) is reduced to a sclerite corresponding to the intercoxal process of text-fig. 2, there being no transverse suture immediately behind the mid coxae.



TEXT-FIG. 2.

The sterna are flat centrally and more or less strongly slanting laterally, the sides forming usually a distinct angle with the central plane. The deeply hollow sides of the prosternite serve as a retreat for the modified fore legs, and have no hairs.

The legs, which are long and more primitive in the American forms and short and more specialised in all the Old-World species, are different to some extent in every species, distinctions obtaining in the number, size and position of the bristles, the number of pseudo-joints in the tibiae and in the structure of the tarsi. Speiser, in demonstrating the fairly close agreement between the *Polyctenes* tarsus and that of *Cimex*, came to the conclusion that the tarsus of *Polyctenes* consists of three segments, of which the second is divided by a pseudo-joint. We agree with this conclusion. Although the pseudo-joint is sometimes very distinct, it is never so well defined as the joints between the true segments. In several cases the pseudo-joint is hardly indicated (Pl. XIII. fig. 7, XIV. fig. 13). The tarsi of the immature specimens, as must be expected, have a segment less than the adults, the end-segment being long and undivided (Pl. XIII. fig. 8), the division taking place a short distance beyond the first segment in or near the spot where the pseudo-joint of the adult is situated.

The claws vary from being nearly alike, as in the American *Polyctenids*, to being very asymmetrical (Pl. XIII. fig. 7). It is always the inner claw which becomes reduced, the outer claw at the same time being enlarged. The inner claw is the one on the side nearest the body. As the body is broad and flat, the mid and hind legs as a rule stretch out sideways, the femur and tibia forming

a horizontal angle, not a vertical one, as for instance in Locusts or Carabids, this applying more especially to the hind legs. Both legs, however, can assume an obliquely upright position, more particularly in young specimens with small elytra and narrow abdomen and in the long-legged American *Polyctenidae*. The upper surface of the horizontal hind leg of fig. 10 (Pl. XIV.) corresponds to the inner surface of the Locust leg. The small claw, in a view from above, therefore, lies on top of the large one. The most asymmetrical claws have the base produced into a large tooth (Pl. XIII. fig. 7), which is only indicated in the less asymmetrical claws (Pl. XIV. fig. 13) and in the symmetrical ones. Proximally to the claws, on the ventral side, the extension-plate projects from the third segment, and near the apex of this plate there is a pair of thin bristles as in most other insects. In some species the extension-plate is supported by a projection from the segment which is triangular in a lateral aspect (Pl. XIII. fig. 7). In the American form and one of the African ones (Pl. XIV. fig. 13) the sole of the apical segment is armed with very stout short spines, which presumably have the function of taking hold of the hair of the host, which is accomplished by the basal projection of the claws of the other species (Pl. XIII. fig. 7), whose tarsus bears only small spines in the place where those large ones are situated. The spines are not present on both sides of the segment, but form a single row, which is placed near the outer (or under) side, *i.e.* the side of the larger claw.

The false segmentation of the mid and hind tibiae is most pronounced in the American forms and least developed in the remarkable African species depicted on Pl. XIV. In this latter species there is a slight indication of a division near the base and only one other pseudo-joint, which is placed in the centre (mid tibia) or beyond (hind tibia). A test of the movability of the pseudo-segmented tibiae of alcohol specimens proves them to be very flexible, but shows at the same time that the segmentation is only partial or superficial.

One of the most striking features of the *Polyctenidae* is the reduction which obtains in the forelegs throughout the family, more especially in the tarsus. As in the other tarsi, the American forms are also here less modified than the Old-World species. There are always three segments to the fore tarsi of adult specimens. While, however, in the American forms there is no difficulty in finding the parts homologous to those of the other tarsi, the bristles placed at the apex of the third segment and the claws are so modified in the species of the eastern hemisphere that it is not always easy to say which is claw and which bristle. The end-segment of the fore tarsus of an Old-World species (Pl. XIII. fig. 9) bears indeed little resemblance to that of the other tarsi (Pl. XIII. fig. 7). The two claws of this segment are small and slender, and can only be distinguished from the thick bristles placed near them by using a higher magnification, the larger of the two claws being generally curved and twisted, but sometimes obtuse.

We do not know what the function of the modified fore leg is, but we may guess at it from its structure. Three points strike us as being suggestive. The first is that the anterior femur is large, being in proportion to its length wider than the other femora, and carries a considerable muscle-power, which must have its use. Secondly, in consequence of the shortness of the tibia and tarsus, which move against the femur like the blade of a clasp-knife against the handle, the power of the femoral muscles is rendered more effective in a downward movement of the tibia than if the tibia and tarsi were long. Thirdly, we find in all males at the apex of the tibia on the true ventral side a membranous lobe which bears

numerous thin long hairs, forming a kind of tuft (Pl. XIII, fig. 9). This organ being confined to the male, or at the most slightly indicated in the female, may be interpreted as serving a sexual purpose. It appears therefore highly probable to us that the fore leg is used by the male in taking hold of the other sex. But as it is reduced to the same degree in both sexes, it may have other functions as well. We do not think that it can be employed when the insect glides through the fur of the host, as the erect bristles of the tibia and tarsus would be a serious hindrance. As the bristles of the femur and those on the side of the tibia (Pl. XIII, fig. 6) are directed backwards, *i.e.* those bristles which come into contact with the hair of the host when the fore legs are tucked away underneath the hollow sides of the prothorax, we believe that the forelegs are kept in this position when the insect moves about.

Apart from the sensory hairs, the bristles of the body and appendages serve two purposes: protection and adhesion. Firstly, they obviate undue friction with the hair of the host and prevent the hairs from getting in between the joints; and secondly, they render it practically impossible for the insect to slide backwards through the fur by its own weight and fall off the host. Like fleas, the Polycetenids can only move forward in the fur, the bristle being directed backward, rendering the surface smooth from the frontal side and rough from the anal direction. Many of the long bristles, particularly the bristles of the tibiae, are semi-erect and divergent, and serve as supports for the body by resting on the hairs of the host, in the same way as by means of its numerous branchlets a broken-off twig may remain hanging in a bush. From this point of view the tibiae of the American Polycetenids are interesting, as they bear at the outer edge some exceedingly long and thin bristles, some of which equal the tibia in length.

The number of abdominal segments is ten in the immature specimens and nine in the adults, the basal segment of the young apparently disappearing or fusing with the metathorax in the final instar. Apart from the greater or lesser breadth of the abdomen, the species differ as a rule in the number and length of the hairs, and in one case there is also a sexual difference, the males lacking some of the hairs and bristles of the females.

In order to complete our short survey of the morphology we must briefly enter upon a point which is of equal importance for the systematics of the family as for phylogenetic considerations—that is, the question as to the differences between adult and immature specimens.

We have examined five immature examples belonging to several species, and found them to agree in the following points: The proboscis has the same number of segments and essentially the same structure as in adults of the same or allied species. The elytra are shorter, and, like the pronotum, are devoid of punctures. The bristles of the upper and under sides are fewer in number. The sternal sclerites are less well defined, but the prosternum is practically as in the adult, apart from the bristles. Between the metanotum, which is visible on account of the elytra not being fully developed, and the segment which bears the first abdominal stigma there is a transverse sclerite not noticeable in adults, and presumably representing the true first abdominal tergite. The tarsi consist of two or three segments, and further differ from adult tarsi in the second joint (= division between segments 2 and 3) being situated close to the first in or near the place where the adult tarsus has a pseudo-joint, the third segment being long and undivided. The upper side of the body has no combs or spines, or

only one or two, in the latter case the second being placed at the apex of the elytra. The missing comb or combs are represented by a row of bristles.

The first segment of the antenna of the Old-World *Polyctenidae* has a smaller number of thick stumpy spines in the immature specimens we have examined than in any of our adults, or has only bristles (Pl. XII. fig. 3). The only young American example we have before us, however, has a comb of spines on the first antennal segment which is not present in adults of the same genus, the individual as a compensation lacking the gular comb. It is interesting to note that the gular comb, though present in our immature individuals from Asia and Africa, in these examples does not extend so far backwards at the sides of the head as in the most nearly allied adults.

These are general statements in which no cognisance is taken of the question whether any of the young specimens belong to any of the species represented by our adult individuals, or whether they are immature forms of which the adults are not yet known. As we have to assign a place in classification to each individual before us, *i.e.* as we have to decide whether an immature specimen belongs to one of the adults or to a separate species, we must ask what guide we have in arriving at a decision. From the above statements so much is certain, that an immature individual which is similar to an adult one, but exhibits some such deficiencies as are mentioned above, must not be considered a distinct species on account of these deficiencies alone. Therefore, if adult and immature specimens which are obtained from the same host and in the same locality differ only in that way, one can be tolerably sure that they belong to one and the same species. As an instance we refer to the two forms represented by figs. 1 and 3 on Pl. XII. Both specimens were found in the British Museum in a jar with bats from China, and one is adult (a ♀) and the other immature. The original specimens of *Polyctenes molossus* which Giglioli collected on a bat at Amoy are this same species, and curiously enough one also is immature and the other (but this time a ♂) adult. Here, we think, there can be no doubt that the differences between the two specimens are only due to the difference in the degree of maturity.

As in most cases the newly formed epidermis, with its hairs and spines, can be seen within the old skin of the immature examples, one must expect to meet with individuals in which the old skin has the characters of the pupal stage and the new skin those of the imago. If we are right in considering figs. 1 and 3 as depicting different stages in the metamorphosis of one species, individuals must occur which have no combs on the upper surface, like fig. 3, while beneath the skin the newly forming combs of fig. 1 are visible. Now it is a curious fact that in Westwood's figure of a non-adult specimen, and in those of our immature individuals where the bristles and spines of the new skin are at all distinguishable, the newly forming skin does not exhibit any obvious differences from the old one. We can only explain this fact by assuming that the young Polyctenid is born with a certain skin armature which does not essentially change at the larval moults, the chief larval characteristics being preserved until the later moult. However, the stage in the life-history of the individual which is missing in the collection of the British Museum was discovered two years ago by Dr. Speiser, who received for description a specimen from the Indian Museum, which proved to be a nymph before the final moult. This specimen is described as having dorsally only one comb, which is placed at the hind edge of the head. But under the skin Dr. Speiser found the newly forming imago with a distinct comb on the pronotum

as well as on the elytra. Applying this discovery to the immature and adult specimens from China (figs. 1 and 3 of Pl. XII.), no dorsal combs can be expected to put in an appearance in this species until the imago is being formed in the last nymphal instar.

Since in the insects with incomplete metamorphosis the elytra are in a state of growth in the immature instars, while the head and thorax are already more or less shaped as in the imago, one might deduce from this generally applicable fact the *a priori* opinion that in the Polyctenids the comb of the elytra invariably appears at a later instar than the comb of the pronotum. This is not the case. The specimen figured at Pl. XIII. fig. 8, which is immature, has combs on the head and elytra, but not on the prothorax, and is, we think, a nymph belonging to fig. 5, the specimens being obtained together. The specimen was unfortunately glued on a card, and the new individual inside the old skin is not advanced enough to show any bristles and spines. That is much to be regretted, since the appearance of a pronotal comb on the specimen forming in the nymph would be the best evidence that our nymph fig. 8 actually belongs to the species fig. 5. It is interesting to note that Dr. Speiser* draws the conclusion that the elytral comb appears before the thoracical one in the individual life, which does not seem warranted by his specimen of a nymph, but is borne out by our fig. 8. It is perhaps necessary to mention that this conclusion also does not apply to those species of which the imago has a comb on the thorax but not on the elytra.

We have further evidence of an irrefutable kind that the young differ from the adult in the absence of certain combs. The proof that this is so was accorded to us by the discovery of a young Polyctenid in the abdomen of its mother. The embryo is well advanced, the combs, bristles, and claws being already strongly chitinised (brown). While the mother (Pl. XIII. fig. 5) has three dorsal combs, the offspring possesses only one (on the head). Moreover, the first antennal segment bears only one broad obtuse spine in place of the row of spines found on this segment in the mother. If fig. 8 really is the pupa of this same species, three stages are known: the embryo, with one dorsal comb (on the head); the pupa, with two (on the head and elytra); and the imago, with three (on the head, pronotum, and elytra). A less advanced embryo is contained in one of our females of another species (*talpa*).†

CLASSIFICATION.

Systematics are primarily based on a knowledge of the characters which separate one species from the other. A classification cannot be built up merely on the distinctions exhibited by the various specimens. We have to discriminate between these differences, as otherwise individuals which are different because some are immature, for instance, and others adult, or because they are of opposite sexes, might be placed widely apart from each other in the scheme of classification. In our case a classification based, *e.g.*, on the presence or absence of combs would be entirely erroneous. An investigation into the taxonomic meaning of the differences, therefore, is essential for the correctness of a classification as opposed to a mere arbitrary grouping of the individuals. The differences observed may be those between

- (1) adult and immature individuals of the same species,
- (2) the sexes,

* *Rec. Ind. Mus.* iii. p. 271 (1909).

† These young Polyctenids will be described and figured in another place.

- (3) individuals of the same species in the same instar,
- (4) succeeding broods,
- (5) specimens of a species from different countries, or
- (6) distinct species.

The first point has been dealt with above, and some characters which distinguish the adult male from the female are also mentioned in the account of the morphology—namely, the tuft at the apex of the fore tibia in all species, and the smaller number of hairs on the abdominal tergites in some—the males, moreover, bearing an organ of copulation directed, as in the bed-bug, towards the left side (in Westwood's fig. A of Pl. 39 it is erroneously drawn as being directed towards the right side: cf. infra, *P. molossus*).

We know nothing about point (4), and as regards (3) and (5) the number of specimens known is far too small to allow us to draw any definite conclusion as to the extent of variation in these insects. All we can say is that the few adult individuals we have of the same sex of a species, and from the same place, agree very closely with each other, the number and position of the bristles and the number of spines in the combs only varying within narrow limits. For the study of geographical variation, likewise, a far larger material is required than the collections contain at present. The ♀ of *P. molossus* from China and the one from India in the British Museum do not appear to differ.

Up to 1906 the species of *Polyctenidae* were dealt with under the one generic name *Polyctenes* Gigl. (1864). At that time four species (or what were thought to be distinct species) were described from the Old World and two from the New. These Kirkaldy (1906) separated into four genera, the distinctions not being taken from actual specimens, but from the descriptions and figures of former authors, the generic names being *Hesperoctenes*, *Polyctenes*, *Euroctenes*, and *Eoctenes*. Horváth, in 1910, correctly made *Euroctenes* a synonym of *Polyctenes*, and proposed two new genera—*Ctenoplax* for a species described by himself, and *Synerotus* for two species described by Speiser and unknown to Horváth in nature. *Synerotus* being pre-occupied, Horváth in 1911 proposed the name *Hemischizus* in its stead. In the present paper we add another new genus.

The number of species being still less than a dozen, it might be considered unnecessary to distribute them over several genera, and it requires, therefore, a few words of explanation why we follow Horváth's classification, at least to a certain extent, rather than place all the species in one genus.

Systematics are didactic, the systematist presenting either a description of facts or a reasoned interpretation of facts. This holds good throughout the publications on systematics, with the exception of *nomina indscripta*, which on that ground we consider outside the pale of the systematist. Approaching the question of genera from this point of view, it is evident that genera are not mere divisions of a family which are established for the sake of convenience, but have an educational value. The diagnosis of a genus teaches us that the species grouped together therein have certain affinities with each other (which the evolutionist calls evidence of blood-relationship) in contradistinction to the members of other genera. If, therefore, the species of a family are divided strictly according to relationship into a greater number of well-defined genera, the student new to the subject, or the would-be describer of a new species, is at once made acquainted with the characters which are of importance for the recognition of relationship, and at the same time

is compelled to study his specimens more intrinsically, and thereby enabled to draw up a more adequate description.

Now, it is obvious that the diagnosis of a genus would not teach us anything more than the diagnosis of a species, if a genus were erected for every species. The genus should remain a division above the species: otherwise it would be a mere encumbrance. Therefore we take it that one generic term would be sufficient in the family *Polyctenidae*, if the affinities between the various species were pretty equal. But that is not the case. The American forms, of which there appear to be two, stand quite apart from all the Old-World species, and these latter again fall into several natural groups, which is sufficient justification for dealing with the separate branches of the family under different generic terms. Of some of these branches we know so far only one species, which for that reason stands isolated in the family.

A key to the genera and species will be given at the end of this revision.

1. GENUS: *Polyctenes* Gigl. (1864).

Antennae longae, capitis angulos basales superantes, articulo secundo clipei latitudine minus quam tertia parte brevior. Angulus basalis capitis non acute productus, plus minusve obtusus. Elytra apice singulatim fortissime rotundata sine ctenidio.—Genotypus: *P. molossus* Gigl. (1864) specim. matur. ♂.

Patria: Asia.

Polyctenes Gigl., *Quart. Journ. Micr. Sci.* (n.s.) iv. p. 25 (1864) (type: *Molossus*); Westw., *Thesaur. Ozon.* p. 198 (1874) (partim); Waterh., *Trans. Ent. Soc. Lond.* p. 309 (1879) (partim); id., *l.c.* p. 319 (1880) (partim); Speiser, *Zool. Jahrb., Suppl.* vii. p. 373 (1904) (partim; affinity; key to the species); Kirkaldy, *Canad. Entom.* xxxviii. p. 375 (1906) (restricts *Polyctenes* to *molossus*); Kellogg and Paine, *Entom. News* xxi. p. 401 (1910) (verbal quot. of Kirkaldy's synopsis); Horv., *Ann. Mus. Nat. Hung.* 573 (1910) (key to the genera; *Euroctenes* Kirk. syn. with *Polyctenes*), id., *Mém. I. Congrès Intern. Entom.* p. 251 (1911).

Euroctenes Kirkaldy, *Canad. Entom.* xxxviii. p. 375 (1906) (type: *lyrae*).

Giglioli's descriptions of the genus and species read as follows:—

“Head large and prominent, elongated, obtuse, and rounded in front; on its posterior dorsal part is a place of a nearly semicircular form, edged all round with thick spines. On the sides of the fore part of the head are two three-jointed organs (antennae?), bent backwards. A short neck-like piece joins the head to the thorax, which is elongated and divided into two parts.

“The *prothorax* is double the size of the *metathorax*, and is bordered posteriorly with a line of large spines, as those on the head of the male.

“Abdomen of moderate size; it enlarges distally, and is segmented.

“Anterior legs rather short, the two following pairs rather long and slender.

“*Polyctenes molossus*, Westwood and Giglioli (Pl. Ib, figs. 13 and 14).—This remarkable creature inhabits the Chinese *Molossus*.

“Body of a light colour, about $\frac{5}{16}$ ths of an inch in length. Head rounded in front, where a well-marked clypeus, of a nearly semilunar shape, is divided off; just under its posterior angles are inserted the two antennae (?); over their insertion are five large spines on each side; these do not exist in the other specimen, which I take to be a female. Each antenna consists of three rather thick cylindrical joints, the basal one being the thickest; a few hairs fringe their inner borders, and they are bent backwards. Do they at all correspond to the organs which have been termed *palpi* and *maxilli* in *Nycteribia*? The integument of the head is finely striated;

a few hairs are scattered over it. I could make out nothing like eyes, and therefore suppose that these organs do not exist.

"The buccal apparatus appears well developed, and very similar to that of *Nycteribia*. At the back of the dorsal part of the head is a large semilunar plate, wider than it: its anterior margin is fringed with large truncated spines, while the posterior margin has a row of lanceolate spines; in the female this plate is rather smaller, and has anteriorly a double row of large spines, and posteriorly an incomplete row of large hairs.

"The *thorax* is large, covered with hairs; the prothorax is sub-oval, fringed posteriorly by a line of large lanceolate spines; the prothorax of the female is more distinct, and has not the posterior line of spines. The *metathorax* in the male is much smaller than the prothorax, and ends in a point; in the female it consists of two oval pieces.

"The *abdomen* is divided into nine segments in both my specimens, one of which I take to be a male; it has a broader abdomen, with a pointed, bent, copulatory organ on the last segment. In both sexes the abdomen is covered with hairs.

"The anterior legs are short and strong, terminating in two small claws and several spines; their *femora* are very broad. The intermediate and posterior pairs of legs are much longer and more slender. Their tarsi terminate in two uncinated and sharp claws, with two tubercles at their base in the male, and lower down on the tarsi of the female are two more claws. I observed no rudiments of wings.

"All the insects described in this paper were collected at Amoy."

We have quoted the description verbally in order to show that it is mainly based on the adult specimen which bears two combs on the dorsal side. This example, therefore, is the name-type, which it is necessary to state, as there is a remote possibility that the immature individual represents after all a different species, the evidence from which we conclude that the two specimens are one species not being direct, but circumstantial.

The proboscis (Pl. XII. fig. 2. 4) consists of four segments, of which the first is very short, the second slender and entirely open on the anterior side, the third short and also open, and the last the longest of all. The clipeus has no prominent fan-like incrustation beneath. The two halves of the gular comb are centrally close together, which accounts for the strong reduction in width of the second segment of the proboscis. The posterior spines of this comb are long and project much beyond the lateral margin of the head. The posterior edge of the head, on the dorsal side, is less closely applied to the thorax than in the other *Polytenids*, especially at the sides, the angles being so slightly produced backwards that there remains a gap between the head and pronotum.

The antennae are characteristic, being essentially longer than in all the other Old-World forms, but shorter than in the American species (*Hesperoctenes*), the apex of the third segment reaching a little beyond the hind angle of the head. The second segment is a very little less than one-third shorter than the clipeus is wide from side to side, and bears only bristles and hairs, no short thick spines.

The elytra are fused from the base to about one-third and then separated. The apical margin being quite evenly rounded, there is a large triangular gap between them.

The prosternum extends in between the forecoxae, ending in an obtuse process whose tip is sinuate. In the mid and hind legs the tibiae have at least four

pseudo-joints, and the second segment of the tarsi is divided in the adult by a pseudo-joint.

Oriental Region.—Only one species is known.

1. *Polyctenes molossus* Gigl. (1864) (Pl. XII. fig. 1-4).

Ad.—Supra capite pronotoque etenidio instructis ; etenidio gulari capitis angulos basales fere attingente ; segmento 1° dorsali abdominali setis longis vestito.

Iuv.—Supra sine etenidiis ; etenidio gulari ante melium lateris terminato ; abdomine sine setis longis ; tarsis quatuor posticis triarticulatis, articulo 3^{io} duobus primis simul sumptis fere duplo longiore ; articulo 1° antennarum absque spinis crassis obtusis.

Patria : China, India.

Polyctenes molossus Giglioli, *l.c.* (Amoy, off *Molossus*) : Westw., *l.c.* tab. 39. fig. A.B., tab. 40. fig. A—E (1874) (“♀” ex errore).

Polyctenes lyrae Waterhouse, *Trans. Ent. Soc. Lond.* p. 311. tab. 9. fig. 1. 2 (1879) (Secunderabad, Madras Pres., off *Megaderma lyra*, one specimen) ; Speiser, *Zool. Jahrb. Suppl.* vii. p. 375 (1904) ; Dist., in *Fauna Brit. Ind., Rhynch.* iii. fig. 10 (1906) ; Speiser, *Rec. Ind. Mus.* iii. p. 272 (1909).

Euroctenes lyrae Waterh., *Kirkaldy, Canad. Ent.* xxxviii. p. 375 (1906).

The original specimens, which have not been traced yet, require re-examination. Westwood's figures, although wonderful in execution, are obviously deficient in detail. The specimens were mounted in balsam and evidently flattened by pressure, being rendered so transparent, according to Westwood, that “it was very difficult to determine the precise differences between some portions of the dorsal and ventral surfaces of the insects.”

The British Museum contains two specimens taken off a Chinese bat, one a ♀, the other immature, which agree with Westwood's figures, except for some detail in the proportions and in the bristles and spines. The adult ♀, moreover, is identical with the Indian ♀ described by Waterhouse as *lyrae*. This *lyrae* has always been considered distinct from *molossus* on account of the much longer head shown in Waterhouse's figure and some differences in the details of structure. Kirkaldy even thought the differences important enough for separating *lyrae* and *molossus* generically. However, in the original figure of *lyrae* the proportions are not quite correct. We have measured the type of *lyrae* under the microscope, the specimen now being taken off the card and made accessible for minute study by being mounted in balsam. The measurements as well as the combs and bristles are the same as in the Chinese ♀, of which Pl. XII. fig. 1 and 2 are fairly correct representations, we think.

As regards the original figures of the adult specimen of *molossus*, they differ from the specimens of *lyrae* chiefly in the following points : The first segment of the antenna lacks the short spines which in *lyrae* (Pl. XII. fig. 2) are placed near the anterior edge. The sides of the pronotum are almost evenly rounded, the prothorax being widest before the centre instead of behind it. The sutural gap between the elytra is much smaller, and the suture itself is drawn as extending to the base.

As the prothorax is hollow underneath, the sides being turned downward, it becomes considerably wider anteriorly if pressure is applied. This was undoubtedly the case in the type of *molossus*. We mention further on a specimen of *Eoctenes nycteridis* in which one side of the pronotum is widest before the middle

and the other behind, the one side being less flexed downward than the other. The absence of the anterior short spines from the underside of the first antennal segment may be attributed to an error of omission, and the undue length of the black line which represents the suture of the elytra is doubtless owing to being drawn diagrammatically.

There are also numerous discrepancies between the specimens of *lyrae* and the figures of *molossus* in the number of bristles; but here again the figure is decidedly diagrammatical, especially as regards the antennae, thorax, elytra and legs. However, some of the differences may be sexual, Westwood's figure representing a ♂ and ours a ♀. The roundness of the head, especially the apparent absence of slightly projecting basal angles (cf. our fig. 1 on Pl. XII.) and great width of the abdomen, may be explained by the artificial flattening of the specimen, and the organ of copulation being directed towards the right side instead of towards the left by assuming that the upperside (Westwood's fig. A) was drawn by viewing the transparent specimen from beneath. Westwood erroneously considered this organ an ovipositor and for that reason regarded the individual as a ♀, treating the second, immature, specimen as being perhaps the ♂. The figure of this second specimen differs from the individual we figure at Pl. XII. figs. 3 and 4 in the obviously broader head and pronotum, which may be explained as in the case of the adults. The differences in the hairs can hardly be considered of any weight. Judging from the antennae, *e.g.*, as drawn by Westwood, it is evident to us that the figures were not meant to be faithful reproductions of all the minute detail.

Under the skin of our immature specimen the new skin can be seen, the gular comb and the bristles being quite plain. The new skin bears again rows of bristles at the hind margins of the head and pronotum, not combs of spines.

All the evidence points to this immature *Polyctenes* being a young example of *molossus*, the differences from the adult being such as one would expect to obtain between the imago and an earlier instar. The specimen would have had to undergo at least two more moults before turning into an imago. It is much damaged at the legs and many of the bristles are broken.

For the sake of brevity we abstain from describing those parts which are represented by our figures.

Adult female (Pl. XII. fig. 1. 2).—The first and second abdominal tergites bear an irregular row of short bristles, the row being doubled or trebled towards the sides; along the apical margin there is also a row of longer bristles, which about equal in length a segment and are directed obliquely inward. These long bristles are absent from the other tergites, on which the short bristles, however, are more numerous than on the first and second, forming centrally two or three irregular rows. Tergites iii to vi, moreover, have an apical row of bristles separated from the others and medianly widely interrupted. The bristles on the under surface of the abdomen are exceedingly abundant, densely covering the whole surface.

The prosternum resembles that of the immature specimen (Pl. XII. fig. 4), but the hairs are rather more numerous. The meso- and metasterna, whose outline is represented by text-fig 2 (p. 561), are nearly evenly studded with bristles.

The mid femur bears on the under side four or five and the hind femur three or four long bristles which are about as long as the femur is broad (in a dorso-ventral direction) a short distance from the apex. The hind tibia has about ten pseudo-joints. The mid and hind tarsi consist of three segments, but the second is halved by a pseudo-joint. The claws are very dissimilar, the large one

bearing a very large basal tooth and the small one being merely rounded-dilated at the base. In the fore tarsus the claws are placed close together as in the other tarsi, and ventrally to them there are five bristles, four being short and obtuse and the fifth long, pointed and twisted. There is a patch of short hair at the apex of the fore tibia (♀), which corresponds to the male-tuft of other species.

Immature specimen (Pl. XII. fig. 3. 4).—The abdomen has far fewer bristles than in the adult female, above as well as beneath, and the proximal tergites have no particularly long ones. The suture which in text-fig. 2 separates the meso- from the metasternum is only slightly indicated, and the intercoxal metasternal process is broad at the apex and much less chitinised. The fore tarsus consists of only two distinct segments instead of three, and the longest bristles among those which are placed ventrally of the claws is straight, not twisted. The mid tarsus (only one is preserved, the hind tarsi also being missing) has three segments, the third being twice as long as the first two together.

The British Museum collection contains :

1 ♀ adult (type of *lyrae*) from Secunderabad, India, taken off *Megaderma lyra*.

1 ♀ adult from China, taken off a bat in the Brit. Mus.

1 immature from China, taken off a bat in the Brit. Mus.

The last two examples were apparently found on the same specimen of bat.

Specimens in other collections :

The whereabouts of the two original examples from Amoy (a ♂ and an immature specimen) are not at present known.

2. GENUS : *Eoctenes* Kirk. (1906).

Antennae breves, capitis angulos basales acutos non attingentes.—Genotypus : *E. spasmae* Waterh. (1879).

Polyctenes Gigl., Waterhouse (nec Giglioli, err. det.), *Trans. Ent. Soc. Lond.* p. 312 (1879).

Eoctenes Kirkaldy, *Canad. Ent.* xxxviii. p. 375 (1906) (type : *spasmae*).

Ctenoplax Horváth, *Ann. Mus. Nat. Hung.* viii. p. 572 (1910) (type : *nycteridis*).

Syncretotus Horváth, *l.c.* p. 573 (1910) (type : *talpae*).

Hemischizus Horváth, *l.c.* ix. p. 336 (1911) (nom. nov. loco *Syncretoti* preocc.).

The three species which are here united can easily be distinguished from *Polyctenes* by the short antennae (cf. Pl. XIII. fig. 5. 8). The head is widest at the base and closely applied to the thorax, gradually narrowing forward. In front of its dorsal comb there is at each side a transverse row of very minute spines. The two oblique rows of dorsal bristles remain widely apart, instead of nearly uniting behind as in *Polyctenes*. The basal angles are pointed, being directed backward and not bearing a long bristle on the upper side. The adult specimens have three dorsal combs. The posterior spines of the gnlar comb do not project (or exceedingly little) beyond the lateral margin of the head.

The species fall into two natural groups, one corresponding to *Eoctenes* (= *Syncretotus* = *Hemischizus*), the other to *Ctenoplax*. But as the one group consists of only one species, and the other of two which are so closely allied that they may even turn out to be geographical representatives of each other, further discoveries should be awaited before the species are separated generically.

1. Proboscis with four segments ; intercoxal process of prosternum more or less pointed.—*spasmae* and *intermedius*.

2. Proboscis with three segments ; intercoxal process of prosternum obtuse, with tip distinctly emarginate.—*nycteridis*.

1. *Eoctenes spasmae* Waterh. (1879).

Ad.—Rostro quadriarticulato; ctenidio gulari ad angulos capitis usque extenso prosterno angusto precessu intercoxali tenui acuminato; supra tribus ctenidiis; abdominis segmentis 5°—7° (♀) vel 6° et 7° (♂) serie setarum longarum vestitis; ungui minore tarsorum quatuor posteriorum absque dente magno basali.

Iuv.—Rostro et prosterno ut in maturis speciminibus; ctenidio gulari abbreviato; pronoto et elytris sine ctenidiis, illo ante medium latiore quam post medium.

Patria: Sumatra: Nias; Java.

Polycyrtus spasmae Waterhouse, *Trans. Ent. Soc. Lond.*, p. 312, tab. 9, fig. 3, 3a, 4 (1879) (Java, off *Megaderma spasma*, two specimens): Speiser, *Zool. Jahrb.*, Suppl. vii, p. 375 (1904).

Polyctenes talpa Speiser, *Zool. Anz.*, p. 613, text-fig. (1898) (Nias, off *Megaderma spasma* three specimens); id., *Zool. Jahrb.*, Suppl. vii, p. 376, tab. 20, fig. 3, 4 (1904); id., *Rec. Ind. Mus.* iii, p. 272 (1909) (Trivandrum, off *Cynopterus marginatus*, one nymph).

Syncrotus talpa Speis., Horváth, *Ann. Mus. Nat. Hung.* viii, p. 573 (1910).

The British Museum contains two specimens of *spasmae* from Java and two Sumatran examples (♂♀) of *talpa*. The former are immature, and differ so remarkably from *talpa* that the author of the latter was perfectly justified at the time in believing *talpa* to be distinct from *spasmae*. However, a comparison of the two forms revealed to us so many points of agreement that the discrepancies dwindled down to distinctions which were no greater than those between the mature and immature *P. molossus*. Any doubts, however, we might still have entertained about the specific identity of *spasmae* and *talpa* were set at rest by the description given by Dr. Speiser of a nymph from South India which was devoid of combs on the pronotum and elytra, but exhibited these combs under the skin on the newly forming imago. Although this Indian specimen may not actually be the same species as *spasmae*, or may be a different geographical race approaching *intermedius* from Egypt, so much is certain, that it effaces the main difference between the immature *spasmae* and adult *talpa*.

Our adult ♀ of *spasmae* (= *talpa*) contains two embryos, in one of which the dorsal comb of the head is already developed, no other combs being distinguishable.

Adult specimens.—The figures given by Speiser, *l.c.*, and which represent a ♀, are good, giving sufficient and correct detail for the recognition of the species. Only the posterior margin of the pronotum and elytra are not curved enough in the figures, the lateral angles of the elytra particularly being far too distinct. The shading of the figure, moreover, gives the pronotum and elytra the appearance of being convex in the centre, while in our specimens the central depression on the upper side of the head is extended over the pronotum, and the sutural slit of the elytra is continued to the base by a distinct median groove.

The clipeus is longer than in *Polyctenes molossus*, and its posterior central excision narrower and less evenly rounded. The ventral fans are very prominent and the lateral tubercles rather strongly elevate. The second segment of the rostrum is as long as, but distinctly wider than the third, the fourth being widest about the centre and somewhat shorter than the second and third together. The gular comb extends close to the basal angles of the head, and between it and the first antennal segment there is a row of three or four short, stumpy spines.

The prosternum is narrower than in *Polyctenes molossus*, the sides being strongly slanting and the intercoxal process long, strongly chitinised, pointed, and slender. The meso- and metasterna are nearly the same shape as in Pl. XIII. fig. 6, but the mesosternum is rather longer. The metasternite has a peculiar character not found in other species, the pleura being produced laterad into a pyramidal process which extends above the hind edge of the mid coxa.

The proximal abdominal tergites bear one regular row of bristles at some distance from the apical margin, the row becoming irregular and doubled or trebled at the sides; the fourth and following segments also have centrally but one row in the ♂, the row being irregularly doubled in the ♀, which sex has also more numerous bristles laterally than the ♂; the segments v, vi, and vii in the ♀ and vi and vii in the ♂ have an apical row of long bristles, by which this species is easily distinguished from the next. The apex of the fore tarsus is characteristic, bearing five long bristles at the tip. The two central ones of them are evenly curved, being nearly of equal length and slightly widened at their tip. Above them is a long bristle and below them a shorter one, and towards the outer side is placed the pair of claws, the longer claw being longer than any of the bristles, curved and then recurved, and terminating in a long thin point. The smaller claw of the other tarsi is slenderer than in *Polyctenes molossus*.

The fore tibia of our ♂ is so placed that the brush of hairs at its apex can distinctly be recognised as being a membranous flap which bears hairs on the under surface only, *i.e.* on the side away from the tarsus.

Immature specimens.—Waterhouse's figures, *l.c.*, are very characteristic outline drawings of the head, thorax, and base of the abdomen, the armature of the first antennal segment also being correctly represented, as far as correctness can be expected from a representation on a small scale. But as hardly any further details are given in the original description, we have taken some supplementary notes from the type of *spasmae* and the cotype. The first antennal segment bears on the upper side a subapical row of five short bristles, of which the three outer ones are thin and the two lower ones thick. The upper surfaces of the second and third segments bear numerous bristles, two on the second and one on the third being long. On the under side the bristles are fewer in number. The second segment has here two longitudinal rows of four or five, those of the inner row being the thicker, there being also four or five small apical bristles. On the third segment the inner row is represented by three bristles and the outer by one.

The proboscis, clipeus, and the apex of the fore tarsus are almost exactly as in the adult.

The gular comb contains eighteen spines in each half, and does not nearly reach to the basal angles of the head. There is one small bristle behind the comb, another on a level with the last-but-one spine, a larger one before the basal angle, and a small one at the tip of the angle. In front of the comb, between it and the first segment of the antenna, there is one bristle. There are six small but rather stout bristles before the central portion of the hind margin, and one on each side a short distance forward. At the sides of the central channel we find only one exceedingly small hair.

The pronotum is broader than long (6 : 5) and widest before the centre. The greater proportion of the surface is bare of bristles, which are almost confined to the lateral area, base, and apical margin.

The elytra are small, and do not cover the metanotum. They bear bristles

only at and near the margins, four lateral ones on each elytrum being long. Neither the pronotum nor the elytra have a comb of spines.

The prosternum has a less pointed and less strongly chitinised intercoxal process than in the adult, but this process nevertheless differs, as in the adult, from that of *P. molossus* and *P. nycteridis* in its tip being rounded-pointed, not sinuate. The elevate central area of the meso-metasterna is elongate-ovate, and does not bear more than twenty-five bristles, of which, on each side, one near the base, and another near the mid coxa are long. The metapleura are not produced laterad into a process as in the adult.

The fore tarsus consists of two segments. The mid and hind tibiae have seven or eight false articulations. The mid and hind tarsi are slender, and have three segments.

The abdominal tergites bear one row of bristles, there being hardly any additional bristles at the sides. One lateral bristle on each segment is long and strong; the seventh segment has altogether four, and the eighth eight long apical bristles.

The bristles and spines on the newly forming skin are visible under the old one, but do not differ. The nymph, however, described by Speiser, *l.c.*, exhibited the pronotal and elytral combs of the imago under its skin.

The British Museum collection contains:

2 immature specimens (one of them *type* of *spasmae*) from Java, off *Megaderma spasma*.

1 ♂ and 1 ♀ from Sumatra, off *Megaderma lyra*.

In other collections:

1 nymph (armature of imago visible) in the Indian Museum, Calcutta, from Trivandrum, off *Cynopterus marginatus*.

2 specimens (♀ ♀?) in Zool. Institute at Göttingen and 1 in coll. Speiser, from Nias, off *Megaderma spasma*.

2. *Eoctenes intermedius* Speis. (1904) (Pl. XIII. fig. 9).

E. spasmae similis, elytris multo brevioribus, abdomine segmentis posticis absque setis longis seriatis.

Patria: Aegyptus; Sudan.

Polyctenes intermedius Speiser, *Zool. Jahrb. Suppl.* vii. p. 373. tab. 20. fig. 1. 2 (1904) (Egypt, off *Taphozous perforatus*, 2 specimens).

Eoctenes eknomius Kellogg & Paine, *Ent. News* xxi. p. 402. tab. 13. ♂ (1910) (Khartum, 2 ♂♂ and 1 ♀).

Only adult specimens are known.

The original specimens of *intermedius*, a male and a female, are in the collection of the Königl. Zool. Museum at Königsberg. Thanks to the kind services of Dr. A. Dampf, we have been enabled to compare them with the examples from the Sudan (Khartum) in the British Museum obtained by the Entomological Research Committee (Tropical Africa). Three of the five Sudanese specimens were, by an oversight, sent with *Mallophaga* to Professor Kellogg, who described them as a new species, not being aware of the earlier publication of an Egyptian Polyctenid. A ♂ and the one ♀ have been returned by him marked "type." The Sudanese examples agree perfectly with the pair of *intermedius*; the name *eknomius*, therefore, is a synonym.

The figures of *intermedius* and *eknomius* do not quite agree. This is partly due to Speiser's figures being taken from a ♀, while Kellogg and Paine figure a ♂. Moreover, there are several fairly obvious inaccuracies in the drawings. In Paine's figure, *e.g.*, the pronotum is too broad anteriorly, while in Speiser's drawing the elytra are too wide, laterally too evenly rounded, and apically too straight. The sutural slit is continued to the base as a distinctly impressed linear groove in the specimens, but not in Speiser's figure.

The similarity in the detail of structure between *intermedius* and *spasmae* (adult) is very close. But, besides the much shorter elytra, *intermedius* is easily recognised by the posterior abdominal tergites not bearing a row of long bristles at the apex.

The male has only one row of bristles on the abdominal tergites, apart from the additional lateral bristles, while the female has two or three rows and bears in addition two very long bristles on the sixth and seventh segments, one being placed on each side at some distance from the centre.

The prosternum has the same shape as in *E. spasmae*, the anterior margin being rounded in the centre (within the excision) and the intercoxal process being long, narrow, pointed, and strongly chitinised.

The British Museum collection contains :

3 ♂♂ (among them the type of *eknomius*) and one ♀, received by the Entomological Research Committee (Tropical Africa), from Harold H. King, who found the specimens on a bat at Khartoum on September 3, 1909.

Specimens in other collections :

1 ♂ from the same source in the collection of Professor Kellogg ;

1 ♂ and 1 ♀ in the Königl. Zoologische Museum of the University of Königsberg, from Egypt, off *Taphozous perforatus*.

3. *Eoctenes nycteridis* Horv. (1910) (Pl. XIII. fig. 5—8).

Ad. et iuv.—Rostro triarticulato, articulo apicali duobus primis multo longiore ; prosterni processu intercoxali apice parum sinuato obtuso ; tarsorum quatuor posticorum unguibus basi dente magno instructis.

Patria : Africa orient. Germanica ; Uganda.

Ctenoplar nycteridis Horváth, *Ann. Mus. Nat. Hung.* viii. p. 572. tab. 14. figs. 2. 3. 4 (1910) (Shirati, Victoria Nyanza, off *Nycteris hispida*, one specimen).

The artist who drew Horváth's figures did not consult the specimen very closely, as is quite evident from the upper and under sides of the prothorax and from the hind tarsus, which latter is not a Polycetenid tarsus at all. For this reason we consider the four ♀♀ from Uganda which are in the British Museum to belong to *nycteridis* in spite of all the differences from those figures.* Horváth's specimen is doubtless also a ♀. The proboscis is drawn as consisting of four segments (a small basal one and three others), which we attribute to an oversight on the part of the artist ; and the claws in the enlarged drawing of the fore tarsus are certainly quite wrong. The following description is taken entirely from the British Museum specimens.

Adult specimens.—We know only the ♀ sex. There are three dorsal combs as in the adult examples of the preceding species of *Eoctenes*. The bristles on the

* Dr. Horváth, to whom we sent our drawings for comparison with the type of *nycteridis*, informs us that they agree with his specimen.

head and thorax are distributed as shown in our figures (Pl. XIII. fig. 5, 6). Those on the abdominal tergites are very numerous, representing three or four rows in the centre, while the sides are covered with bristles from near the base to near the apex. The posterior bristles of the seventh tergite are more distinctly prolonged than the corresponding bristles of the previous segments, but are less than double the length of the other bristles. The ♂ must be expected to have fewer bristles.

The proboscis (Pl. XIII. fig. 6) consists of three segments, the apical one being longer than the first and second together. All the tarsi have three segments. We give an enlarged drawing of the right hind tarsus (Pl. XIII. fig. 7), which shows the characteristics of the claws very well. The small claw of *nycteridis* has a large basal tooth, which is but vestigial in the previous two species. It will be further noticed that the pseudo-articulation of the second segment is only indicated on the dorsal side of the segment and is placed much nearer the apex than the base. In this all the forms of *Eoetenes* differ from *Polyctenes*, in which the pseudo-joint is distinct all round the tarsus and has a more proximal position. The larger proportion of the inner surfaces of the mid and hind femora is devoid of bristles.

Immature specimen (Pl. XIII. fig. 8; text-fig. 1).—A single immature specimen was obtained together with the adult females. It differs in many points from the adults, the most striking being the absence of the pronotal comb, the shortness of the pronotum, the different shape of the elytra, and the lesser number of bristles. The most interesting parts of the example are the elytra, which, unlike all the other immature *Polyctenids* which we have seen, have a narrow sutural slit, like adults, and a comb. As one of the females contains an embryo in which only the first comb is developed (besides the gular one), the dorsal combs appear in *nycteridis* in the individual life in this succession: first, third, second. The immature specimen has apparently moulted quite recently, no new bristles or spines being as yet visible under the skin. The tarsi consist of two segments, the second segment bearing near the base an incomplete additional articulation (Pl. XIII. fig. 8). The basal tooth of the smaller claw is not nearly so large as in the adult.

The British Museum collection contains:

4 ♀♀ and 1 immature specimen, taken off a bat on the Moffat Road, Entebbe, Uganda, by Mr. E. Degán.

In other collections:

1 ♀ in the National Hungarian Museum at Budapest, from Shirati, on the east shore of Lake Victoria, off *Nycteris hispida*.

3. GENUS: *Adroctenes* gen. nov.

Latus, clipeo ad latera spinis crassis loco setarum instructo; rostro quadri-articulato articulo penultimo brevi; antennis capituli basin attingentibus haud superantibus, articulo secundo ctenidio longitudinali armato; pronoto valde transverso; prosterno late triangulari sine processu intercoxali; pedibus quatuor posticis brevibus, tarsorum articulo apicali ctenidio ventrali armato, unguibus basi haud distincte dentatis.—Genotypus: *A. horvathi* spec. nov.

The species for which we erect this genus is so different from all the other *Polyctenids* that a generic separation is amply justified.

Adroctenes agrees with the American genus *Hesperoetenes* in the second segment of the antenna bearing a comb, in the pronotum being transverse and

closely applied to the head, in the small size of the basal projection of the tarsal claws, the presence of a comb on the under side of the last mid and hind tarsal segment, and in the shortness of the prosternum. On the other hand, its short legs and the dorsal combs are Old-World characters. The new genus, therefore, forms a kind of connecting link between the Eastern and Western Polyctenids.

The tibiae are very remarkable for having only a single pseudo-joint.

1. *Adroctenes horvathi* spec. nov. (Pl. XIV. fig. 10—13).

♀. Densissime setosus; capite pronotoque etenidio armatis; ante pronoti basin serie setarum longarum atque spinarum brevium; elytris rotundatis; abdomine segmentis 7° et 8° serie setarum longarum instructo; tarsis latitudine femoris parum brevioribus.—Long. 3·5 mm.

Patria: Terra Somalorum, Africa orientalis septentrionalis.

A broad and very hairy species, of which the Entomological Research Committee (Tropical Africa), only received one specimen, an adult female, and which we have great pleasure in naming after the distinguished Hemipterist Dr. Horváth. The clipeus is about five times as broad as it is long, its diameter being shorter in the centre than at the sides. The hind margin is more strongly arched in the centre than the anterior margin and bears laterally a row of ten bristles. The lateral bristles on the under side of the clipeus differ remarkably from those of the other Polyctenids, the three central ones being modified into short stout spines (Pl. XIV. fig. 12), and the last proximally incrassate and distally thin, while the first is represented by several minute hairs.

The head exclusive of the clipeus is shorter than broad (proportions 5:7), and its upper surface, with the exception of the anterior portion of the central area, is very densely covered with short and stout but very sharply pointed bristles. The oblique sutures are very distinct and nearly straight. They are accompanied on the outer side by a row of short bristles, laterally to which there is a naked stripe. The spines of the comb at the posterior margin are longer than the bristles placed nearest to them, and twice as long as the spines of the pronotal comb.

The gular comb nearly reaches to the basal angles, and contains 59 teeth on the two sides together. The central gap is as broad as the distance from the tip of the first spine to that of the eighth. Laterally to the comb there is a row of bristles. Close behind the comb six small hairs are placed on the right side of the central groove and four on the other. Farther back the edge of the groove bears six very small hairs on each side, and at and near the basal angles of the head there are three or four short bristles resembling the bristles of the upper surface. The median portion of the hind margin is less produced than is usual in Polyctenids, and also much broader, being nearly twice the width of each lateral portion (12:7). The hind margin is distinctly rounded between the condyli and the basal angles.

The proboscis consists of four segments, of which the last is the most slender, being hardly wider in the centre than at the base. The proportional lengths of the second to fourth segments are: 14, 8, 17. The second segment is open at the base on the anterior side, and the third and fourth segments only appear to have a median groove. The small size of the third segment is noteworthy. The bristles of the second and third segments are rather long.

The antennae, which reach to the basal angles of the head, are quite different

from those of other species. The upper surfaces of the first two segments bear numerous short, stout, pointed bristles, which resemble those on the head. The first segment is longer than broad, and the armature of the under side consists of a median row of ten or eleven stout spines, and numerous short spines near the anterior (= outer) edge. The second segment tapers towards the apex, and is provided above with a comb which extends from near the base to the apex. Beneath this comb the segment is concave, and along the lower edge of this concavity there are several fairly long bristles. The under surface of this segment bears a longitudinal median row of short obtuse spines, and on the outer side numerous short bristles. The third segment has on the upper side an oblique row of strong bristles. The proportional lengths of the four segments are 33, 35, 14, 14.

The structure of the antenna and of the adjacent lateral area of the upper surface of the head renders it evident that the antennae are not laid on the upper side of the head, as in the previous species, but along the edge of it, the edge fitting in between the comb and long bristles of the second segment.

The prothorax is nearly twice as broad as it is long (63 : 35), the notum being a transverse oblong with the basal angles more strongly rounded than the apical ones. The anterior edge is slightly incurved, while the posterior margin is feebly convex. The short bristles are very numerous and have the bases somewhat widened, which gives them the appearance of pointed spines, as is also the case with the bristles on the head. The depressed mesial line is bare of bristles, except for the frontal part, and there is also a transverse bare stripe in front of each comb. The presence of two combs on the pronotum is a very striking feature of this species. The spines of both combs are short. Those of the anterior one are pointed, and only differ from the bristles in being stouter at their bases, the lateral spines of the comb resembling the ordinary bristles. This comb does not quite extend to the point where the stigma shines through from beneath, and behind it there is a row of very long bristles.

The elytra, which are more strongly rounded at the sides than at the apex, have no comb, but are densely setose, with the exception of the apical margin and the basal area. There are a number of bristles near the basal edge, concealed by the overlapping pronotum.

The underside differs very considerably in the shape of the sterna from that of the Old-World genera *Polyctenes* and *Eoctenes*, the species closely approaching the American genus *Hesperoctenes*. The prosternum (*i.e.* the median sclerite) is triangular, being twice as broad as it is long, and just reaches the coxae, not extending in between them. The suture which bounds it laterally and runs from the coxal cavity to the anterior margin of the prosternite is very short on account of the great size of the coxal cavities. The bristles are numerous, but the lateral corners and a small space at each side of the centre are bare of them. Behind the coxae in the middle the endoskeleton shines through. The mesosternum is evenly incurved anteriorly and likewise evenly excurved posteriorly. The central area of it bears many bristles, and there is also a somewhat irregular row near the apical margin. The metasternum is transverse, halfmoon-shaped, and bears a subapical row of bristles and also some subbasal ones.

The larger portion of the under side of the fore femur is without bristles, there being an irregular double row from the outer side to the trochanter and a number of small hairs at and near the inner margin. On the outer side of the fore femur

we find three rows of bristles, those in the row placed on the upper surface being directed backward and those of the other two rows forward. There are also some additional bristles near the apex. The fore tibia has a row of ten fairly long bristles at the dorsal side, and near them on the lateral surface a row of about seven ; towards the inner edge an oblique row of about eight is placed, and at the inner edge there are two long and three short bristles.

The fore tarsus consists of three very short segments, and bears at the apex, besides the pair of unequal claws and a long and some small bristles, two strongly chitinised, short, blunt spines.

The mid femur and particularly the tibia are very densely setose on the outer, upper and lower surfaces, and have comparatively very few bristles on the inner side. The proportional lengths of the segments of the mid leg are : trochanter 37, femur 58, tibia 50, first tarsal segment 11, second 14, third 15. The hind leg is much less hairy than the mid leg, the femur and tibia hardly bearing any bristles on the outer and inner surfaces. The tibia has three rows at the dorsal edge, which look much more crowded in our figure than in the specimen, as they diverge in the insect and are necessarily in a plane in the drawing. The proportional lengths of the segments are : trochanter 42, femur 85, tibia 69, first tarsal segment 12, second 18, third 16. The claws, which narrow but slightly apically, and are hardly at all curved apart from the base, have blunt tips. Both the mid and hind tarsi bear on the ventral surface of the third segment a single row of four thick, short spines, which are very blunt with the exception of the first, which is curved and pointed. The row is not placed in the centre of the ventral surface, but towards the side of the larger claw. The pseudo-joint of the second segment is only indicated (Pl. XIV. fig. 13).

The bristles of the abdomen are exceedingly numerous on the proximal segments, less so on the posterior ones, and all the tergites have a bare space towards each side. Tergites vii and viii bear a row of long bristles, the seventh sternite has hardly any bristles except at the apex, but bears two fairly long ones on each side, one behind the other.

In the British Museum collection :

1 ♀ (adult) from Upper Sheika, British Somaliland, taken off " bats " by R. E. Drake-Brockman on November 25, 1909.

(*To be continued.*)
